**DEPARTMENT OF THE AIR FORCE**
84TH RADAR EVALUATION SQUADRON (ACC)
HILL AIR FORCE BASE, UTAH

1 Nov 99

MEMORANDUM FOR NATIONAL TRANSPORTATION SAFETY BOARD

FROM: 84 RADES/TO
7976 Aspen Ave
Hill AFB UT 84056-5846

SUBJECT: Analysis of Long Range Radar Data: Egypt Air 990 aircraft mishap 31 Oct 99

**1. Introduction.** At the request of the National Transportation Safety Board (NTSB), the 84th Radar Evaluation Squadron (84 RADES) is releasing radar data from various long-range surveillance radars providing coverage for Egypt Air aircraft crash on 31 Oct 99. Comprehensive search and beacon radar coverage of the mishap was provided by the air route surveillance radar-4 (ARSR-4) at Gibbsborro, NJ, Riverhead, NY, Oceana, VA and North Truro, MA. This data was recorded at the Northeast Air Defense Sector Air Operations Center, Rome industrial Park, NY.

The enclosed CD contains all radar data and products produced by the 84th RADES in support of this incident. Software to view the recorded data is included along with quick instructions to view the data (attach 1).

**2. Radar Accuracy Constraints.** The primary range accuracy limitation for both search and beacon is 1/8 nmi, which is the value of the least significant bit in the radar target reports to end users. Azimuth accuracy, primarily a function of radar beamwidth, is approximately 0.2 degree for both search and beacon. Mode C height accuracy is primarily limited to 100 feet, which is the value of the least significant bit in the Mode C altitude report. Mode C altitudes may vary from 'true height' depending on atmospheric conditions. The aircraft's true altitude can be obtained by algebraically adding its corresponding D-value (included in attachment 1) to the Mode C report. In contrast, the ARSR-4 search height accuracy is primarily a function of radar design and the physical world (e.g., propagation conditions and target size). The average search height accuracy, based on specifications, is 3000 ft root mean square (RMS) of the true altitude, but any single radar return height value could far exceed 3000 feet. Therefore, the ARSR-4 height values should be treated as approximate values. A good indication of the relative height error can be obtained by comparing the associated Mode C height (including D values) with the ARSR-4 height measurement. The height measurement values of 102,000 feet indicate the ARSR-4 could not determine the height of the target and are used to represent an invalid height value. In addition to these range, azimuth, and height accuracy factors, the ARSR-4 requires approximately 12 seconds to complete each 360-degree azimuth scan. These scan rates preclude

contiguous aircraft positional information (i.e., prevents a high degree of track resolution). Because of these intrinsic radar limitations, all radar plots illustrated in this analysis on a scan-to-scan basis should be considered close approximations.

**3. Description of products in attachments and Emailed/FTP files.**

a. Attachment 1) – D-Values (pressure-based Mode-C height correction factors)

b. Attachment 2) -- Summary of events reported by MSgt Rauch of the NEADS/84RADES OLAB as he accomplished the initial analysis of radar data.

c. Attachment 3) -- List of all radars recorded in the provided radar data files

d. Attachment 4) – Quick Instructions for use of RS3 Software (Note: We've also included in the FTP directory a more in-depth RS-3 tutorial and sample files)

e. Products Provided

**Egypt Air 990**

**- Coverletter**
- Coverletter Egypt Air 990 – (explanation of products)

**- Data**
- Filtered Flight 990 flight profile (RS3 configuration file)
- Filtered Flight 990 flight profile -- closeup (RS3 configuration file)
- Complete data set (RS3 configuration file)
- Radar Data Interface (RDI) files to feed the configuration files
- Filtered Flight 990 flight profile (MS Excel file)
- Complete data set (MS Excel file)

**-Final products**
- Elevation Plot
- Filtered Flight 990 Profile overlaid on MapInfo data
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4.  If you have any questions or need more information, please contact Mr Lanny Clelland at DSN 777-2035, Commercial (801) 777-2035, or email: lanny.clelland@hill.af.mil.


                                    MARY M. GILLAM, Lt Col, USAF
                                    Commander

Attachments
1.  D-Values
2.  Initial Event Summary (from 84RADES/OLAB, Rome NY)
3.  List of Radars
4.  RS3 Quick Instructions

**Attachment 1**

```
        31 OCT 99 / 1200Z
(TRUE ALTITUDE = MODE C ALTITUDE + D VALUE)

    AIRCRAFT MODE C
    REPORTED ALTITUDE  D-VALUE
    FEET MSL           FEET
     1000.              383.
     2000.              395.
     3000.              405.
     4000.              419.
     5000.              437.
     6000.              463.
     7000.              492.
     8000.              520.
     9000.              547.
    10000.              573.
    11000.              600.
    12000.              629.
    13000.              656.
    14000.              682.
    15000.              706.
    16000.              733.
    17000.              764.
    18000.              796.
    19000.              829.
    20000.              857.
    21000.              883.
    22000.              905.
    23000.              923.
    24000.              941.
    25000.              960.
    26000.              983.
    27000.             1007.
    28000.             1030.
    29000.             1051.
    30000.             1069.
    31000.             1083.
    32000.             1094.
    33000.             1102.
    34000.             1106.
    35000.             1114.
    36000.             1121.
    37000.             1125.
    38000.             1129.
    39000.             1135.
    40000.             1151.
```

*84th Radar Evaluation Squadron*
*Operating Location AB*
*Rome, NY*

## Event Summary
31 Oct 99

1.  At 1110 Z on 31 Oct 99, TSgt Sustarsic NEADS/DOCB recalled OLAB personnel at the request of New York Center to locate the position of Egypt Air flight 990 which they had lost contact with. The last position for the aircraft was forwarded to Maj (CF) LaBelle NEADS/MCC at 1140 Z.  An event analysis was produced and given to the operations crew.

2.  Information used in this report was collected by the 84 RADES/OLAB Radar Data Interface Recorder and presented using RADES system 3.  All information is based on data recorded from J-52 and J-53 ARSR-4 radar located in Riverhead, NY and North Truro, MA.

Released by:    RANDALL M. RAUCH, MSgt, USAF
                NCOIC Air Defense Systems Analysis

## Attachment 3

```
ID        NAME                      EQUIPMENT

R51  BAR  Barrington, Canada        FPS117
J54  BUC  Bucks Harbor, ME          ARSR4
J63  CAR  Caribou, ME               ARSR4
J56  DAN  Dansville (Buffalo), NY   ARSR1E
J62  DTW  Detroit, MI               ARSR1E
J58  EMP  Empire, MI                ARSR4
J51  GIB  Gibbsboro                 ARSR4
J60  NSH  Nashuak, MN               ARSR4
J53  NOR  North Truro, MA           ARSR4
J01  OCA  Oceana, VA                ARSR4
J55  REM  Remsen (Utica), NY        ARSR4
J02  QFF  Ft Fisher, NC             ARSR4
J50  PLA  The Plains, VA            ARSR3
J52  RIV  Riverhead, NY             ARSR4
```

# Attachment 4

This file contains RADES System 3 (RS3) quick start information.

*General Information*

The RS3 Help function should be referenced for "How To" instructions.

The tracks of interest were determined by the 84th RADES.

*RS3 Radar Data Analysis Toolbar*

Many of the tools used in radar data analysis have shortcuts on the toolbar of RS3. The buttons allow the user to call-up certain functions in one simple step, without having to scroll through several different menus. Figure 1 displays the RS3 toolbar and some of its available functions.

Users may select the appropriate buttons on the menu bar to start processing (play), reset (rewind), or stop (pause) the playback of radar messages in RS3. Users can operate use any RS3 function such as turning on the chaining function (chaining connects each radar message for the same track of interest based on the message timestamp) by clicking on the appropriate menu bar button.
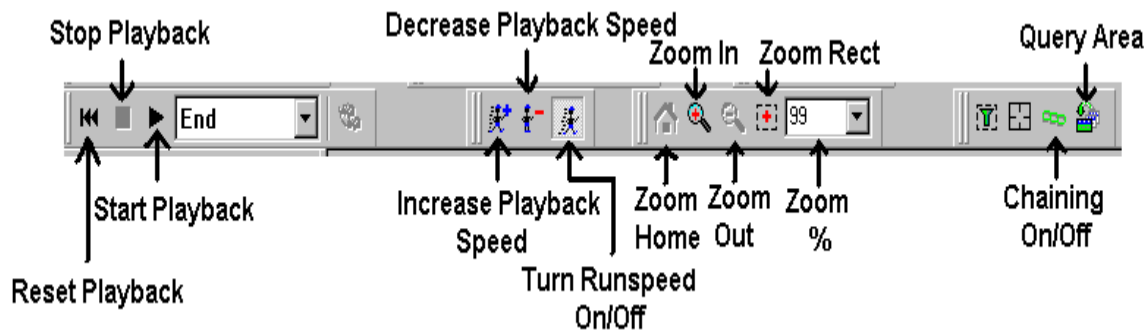


**Figure 1. RS3 Radar Data Analysis Toolbar**

*Quick Instructions for using RS3 and the RS3 Project Files*

1) Follow the directions in the RS3 Installation Instructions.txt file to install RS3 on your system.

2) Copy all files to your hard drive, keeping the same file/directory structure.

3) If you copied the files from a CD-ROM, you will need to take the "Read Only" attribute off of each file in the Data folder.

      a) To do this, right-click on each file and select Properties from the pop-up submenu.

      b) Uncheck the "Read Only" check box in the attributes section.

      c) Click OK.

Do this procedure for each file in the Data folder you copied from the CD-ROM.

4) Go to Start-->Settings-->Control Panel-->Display

On the Settings tab, set the resolution (Desktop Area) on your
system to 800X600.  Use your mouse to move the slide arrow
(in middle right side of the screen) to change the resolution.
Click OK.

*** This is very important since the RS3 projects were saved in
in this resolution and will not be displayed properly unless the
resolution is changed to 800X600

5)  Start RS3 by either double-clicking on the RS3 shortcut on your desktop (if one exists) or going to Start-->Programs-->RADES-->RS3

6)  Go the File menu and select Open Project.

Browse the files in the Data folder until you find the project file ("RS3" file) you want to open.
Select the project file; click Open.

7)  To run the playback, click the Play (start processing) button in upper left-hand corner (next to a small text drop-down menu with the word "End" in it).

8)  To zoom, click the zoom menu button (red cross with dashed  box border) on the top right corner of the lower taskbar.  This allows you to zoom in an area of interest.

Begin at the upper left hand corner of desired zoom area.  Press
and hold the left mouse button; drag the mouse to lower right
hand corner of the desired zoom area and release the mouse
button.  RS3 will zoom in on that area.

You can always revert to the original configuration by selecting
the "home" menu button (looks like a home).

### *An Introduction to RS3*

Please read our "Introduction to RS3" document included on this CD-ROM.  This document is in Microsoft Word format.  This guide will help you get started using RS3 and includes several practice exercises to help familiarize you with RS3.

### *Contact Information*

If you have any questions please contact Mr. Lanny Clelland at (801) 777-2035 or Mr. Dallas Stone at (801) 777-3194.